CLAIMS

WHAT IS CLAIMED IS:

1. A device comprising a surface and a functional layer associated with the surface, wherein the functional layer comprises particles having a structure substituted with a functional group, wherein the functional group is adapted to modify a property of the device, the device is sufficiently biocompatible for application to a multicellular organism and the particles have an average diameter of about 5 nm to about 10 microns.

2. The device of claim 1, wherein the device is an implantable device.

3. The device of claim 1, wherein the device is a drug delivery device.

4. The device of claim 1, wherein the device is an outer surface contacting device adapted to contact an outer surface of the multicellular organism.

5. The device of claim 1, wherein the multicellular organism is a human.

6. The device of claim 1, wherein the surface is a member selected from the group consisting of a metal, a metal oxide, silicon dioxide, a ceramic, a glass, a glass ceramic, a polymer, and a carbonaceous material.

7. The device of claim 6, wherein the metal is a member selected from the group consisting of aluminum, gold, silver, stainless steel, ferrous alloys, titanium, cobalt, nickel, mixtures thereof and alloys thereof.

8. The device of claim 6, wherein the ceramic is a member selected from the group consisting alumina, zirconia, silica, magnesia, mullite, calcium phosphate, calcium silicate, calcium carbonate, mixtures thereof and alloys thereof.

9. The device of claim 6, wherein the polymer is a member selected from the group consisting of biodegradable polymers, non-biodegradable water-soluble polymers, non-biodegradable non-water soluble polymers, conductive polymers, and biopolymers.

10. The device of claim 9, wherein the polymer is a member selected from the group consisting of polystyrene, polyurethane, polyethelene, polypropylene, poly(oxymethylene), polyacetal, poly(tetrafluroethyelene), silicone elastomer, polyvinylidine difluoride, polysulfone, and poly(methylmethacrylate).

11. The device of claim 9, wherein the polymer is a member selected from the group consisting of poly(pyrrole), poly(aniline), poly(thiophene), and poly(phenylene).

12. The device of claim 6, wherein the carbonaceous material is a pyrolytic carbon or a non-pyrolytic carbon.

13. The device of claim 1, wherein the surface is a member selected from the group consisting of a fiber, a filament, a coil, a tube, a sheet, a foil, a cylinder, a sphere, a mesh, a mat, a gel, and a hydrogel.

14. The device of claim 1, wherein the average diameter of particles is from 5 nm to 1 micron.

15. The device of claim 1, wherein the particles are substantially spherical and have a ratio of a major axis to a minor axis in a range of about 1.0 and to about 2.0.

16. The device of claim 15, wherein the ratio is in a range of 1.0 to 1.2.

17. The device of claim 1, wherein the particles have a polydispersity of less than 0.3.

18. The device of claim 17, wherein the polydispersity is less than 0.1.

19. The device of claim 17, wherein the polydispersity is less than 0.01.

20. The device of claim 1, wherein the structure is an inorganic molecule selected from the group consisting of an oxide, a nitride, a carbide, calcium silicate, calcium phosphate, calcium carbonate, a carbonaceous material, a metal, and a semiconductor.

21. The device of claim 20, wherein the metal is a member selected from the group consisting of aluminum, gold, silver, stainless steel, iron, titanium, cobalt, nickel, and alloys thereof.

22. The device of claim 20, wherein the oxide is a member selected from the group consisting of Al_2O_3, TiO_2, ZrO_2, Y_2O_3, ferric oxide, ferrous oxide, a rare earth metal oxide, a transitional metal oxide, SiO_2, mixtures thereof and alloys thereof.

23. The device of claim 1, wherein the structure is a polymer, and the polymer is a member selected from the group consisting of biodegradable polymers, non-biodegradable water-soluble polymers, non-biodegradable non-water soluble polymers, lipophilic moieties, and biopolymers.

24. The device of claim 23, wherein the polymer is a member selected from the group consisting of polystyrene, polyurethane, polylactic acid, polyglycolic acid, polyester, poly(alpha-hydroxy acid), poly(ε-caprolactone), poly(dioxanone), poly(orthoester), poly(ether-ester), poly(lactone) mixtures thereof and copolymers thereof.

25. The device of claim 1, wherein the functional group is a member selected from the group consisting of a chemical functional group, a biomolecule, a photo-reactive moiety, and a photo-initiator moiety.

26. The device of claim 25, wherein the chemical functional group is a member selected from the group consisting of an amino group, a hydroxyl group, a carboxy group, a –SO_3H group, a –SH group, an –OCN group, a phosphorous group, an epoxy group, a vinylic

moiety, a silane coupling agent, an acrylate, a methylacrylate, a metal alkoxy group, and derivatives thereof.

27. The device of claim 25, wherein when the structure is silica, the functional group does not include an amino group.

28. The device of claim 25, wherein the biomolecule is a member selected from the group consisting of a bioactive polypeptide, a polynucleotide coding for the bioactive polypeptide, a cell regulatory small molecule, a peptide, a protein, an oligonucleotide, adenoviral vectors, a gene transfection vector, a drug, and a drug delivering agent.

29. The device of claim 28, wherein the bioactive polypeptide is a growth factor and such growth factor is a member selected from the group consisting of an epidermal growth factor, an acidic fibroblast growth factor, a basic fibroblast growth factor, a glial growth factor, a vascular endothelial growth factor, a nerve growth factor, a chondrogenic growth factor, a platelet-derived growth factor, a transforming growth factor beta, an insulin-like growth factor, a hepatocyte growth factor, bone morphogenic proteins and osteogenic proteins.

30. The device of claim 29, wherein such growth factor is a member selected from the group consisting of bone morphogenic proteins and osteogenic proteins.

31. The device of claim 1, wherein the property is a member selected from the group consisting of adhesion, friction, wettability, texture and roughness.

32. A method of modifying a surface, said method comprising providing on the surface a functional layer comprising particles having a structure substituted with a functional group and/or associated with a functional moiety such that the functional layer modifies a property of the surface to provide a modified surface, wherein the modified surface is sufficiently biocompatible for application to a multicellular organism and the particles have an average diameter of about 5 nm to about 10 microns.

33. The method of claim 32, wherein the property is a member selected from the group consisting of adhesion, friction, wettability, texture and roughness.

34. The method of claim 32, wherein the functional layer modifies a reaction to the surface of a cell of the multicellular organism.

35. The method of claim 32, wherein the functional layer modifies a reaction to the surface of a tissue of the multicellular organism.

36. The method of claim 32, wherein the modified surface transfects with genomic material adjacent cells and tissue.

37. The method of claim 32, wherein the modified surface delivers bioactive agents to adjacent cells and tissue.

38. The method of claim 32, wherein the modified surface promotes adhesion of the modified surface to a plurality of adjacent surfaces.

39. The method of claim 32, wherein the modified surface promotes adhesion of the modified surface to adjacent cells and tissue.

40. A device comprising a surface and a functional layer associated with the surface, wherein the functional layer comprises monomeric particles having a structure substituted with a functional group, wherein the functional group is adapted to modify a property of the device, the device is sufficiently biocompatible for application to a multicellular organism, and the particles have an average diameter of about 5 nm to about 10 microns, provided that when the structure is silica, the functional group does not include an amino group.

41. A device comprising a surface and a functional layer associated with the surface, wherein the functional layer comprises particles having a structure associated with a functional moiety, wherein the functional moiety is adapted to modify a property of the device, the device is sufficiently biocompatible for application to a multicellular organism, and the particles have an average diameter of about 5 nm to about 10 microns, provided that when the structure is an unsubstituted silica, the functional moiety does not include collagen .

42. The device of claim 41, wherein the structure is non-covalently associated with the functional moiety.

43. The device of claim 41, wherein the functional moiety is a member selected from the group consisting of a growth factor, a bioactive polypeptide, a polynucleotide coding for the bioactive polypeptide, a cell regulatory small molecule, a peptide, a protein, an oligonucleotide, adenoviral vectors, a gene transfection vector, a drug, and a drug delivering agent.

44. The device of claim 41, wherein the structure is an inorganic molecule selected from the group consisting of an oxide, a nitride, a carbide, calcium silicate, calcium phosphate, calcium carbonate, a carbonaceous material, a metal, and a semiconductor.

45. The device of claim 44, wherein the metal is a member selected from the group consisting of aluminum, gold, silver, stainless steel, iron, titanium, cobalt, nickel, and alloys thereof.

46. The device of claim 44, wherein the oxide is a member selected from the group consisting of Al_2O_3, TiO_2, ZrO_2, Y_2O_3, ferric oxide, ferrous oxide, a rare earth metal oxide, a transitional metal oxide, SiO_2, mixtures thereof and alloys thereof.

47. The device of claim 41, wherein the structure is a polymer, and the polymer is a member selected from the group consisting of biodegradable polymers, non-biodegradable water-soluble polymers, non-biodegradable non-water soluble polymers, lipophilic moieties, and biopolymers.

48. The device of claim 41, wherein the structure is substituted with a functional group such that the functional group is adapted to modify a property of the device and the functional group can be the same as or different from the functional moiety..

49. The device of claim 48, wherein the functional group is a member selected from the group consisting of a chemical functional group, a biomolecule, a photo-reactive moiety, and a photo-initiator moiety.

50. An implantable device comprising a surface and a functional layer associated with the surface, wherein the functional layer comprises particles having a structure associated with a functional moiety, wherein the functional moiety is adapted to modify a property of the device, the device is sufficiently biocompatible for application to a multicellular organism, and the particles have an average diameter of about 5 nm to about 10 microns, provided that when the structure is unsubstituted silica, the functional moiety does not include collagen nor an amino group.

51. A method of making the device of claim 1, comprising:

providing a surface; and

providing one or more functional layers on the surface, wherein at least one of the functional layers contains a functional group, such that a property of the device is modified by the functional group to provide the device.

52. A method of making the device of claim 41, comprising:

providing a surface; and

providing one or more functional layers on the surface, wherein at least one of the layers contains a functional moiety, such that a property of the device is modified by the functional moiety to provide the device.